PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
BO 42179		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NL00/00009	06/01/2000	06/01/1999
International Patent Classification (IPC) or national classification and IPC		
H01H71/32		
Applicant		
HOLEC HOLLAND N.V. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
31/07/2000	11.12.2000
Name and mailing address of the international preliminary examining authority:	Authorized officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Simonini, S Telephone No. +49 89 2399 8575

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NL00/00009

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

1-9 as originally filed

Claims, No.:

1-18 as originally filed

Drawings, sheets:

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NL00/00009

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1-18
	No:	Claims
Inventive step (IS)	Yes:	Claims 1-18
	No:	Claims
Industrial applicability (IA)	Yes:	Claims 1-18
	No:	Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

INTERNATIONAL PRELIMINARY EXAMINATION REPORT - SEPARATE SHEET

International application No. PCT/NL00/00009

R It m V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive st p or industrial applicability; citations and explanations supporting such statem nt

1 Reference is made to the following document:

D2: FR 2 697 670 A (MERLIN GERIN) 6 May 1994

2 Line 16 of **claim 1** reads "...and which in the first position of the armature has a magnetic resistance being higher than that of the first magnetic circuit and is decreasing...". Reference should have been made to reluctance rather than magnetic resistance. Claim 1 is therefore understood as reading: "..., the second magnetic circuit having, in the first position of the armature, a higher reluctance than that of the first magnetic circuit, this reluctance decreasing...".

The document D2 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (the references in parentheses applying to this document): a trip system for an electrical switch (title), comprising a yoke of electric material (22,23,24), consisting of a yoke base part (24), a first yoke leg (22) and a second supporting yoke leg (23), said first and second yoke legs extend in a mutual spaced relation and in the same direction from the yoke base part and transversally thereto (fig.2), an armature (25) from magnetic material bridging the free legs of the yoke legs (fig.2), a permanent magnet (27) provided such that its magnetic field lines extend through a first magnetic circuit formed by the yoke and the armature (fig.2), a coil (28) mounted on the yoke and spring means (26) engaging the armature, in which the armature is held in a first position under the influence of the magnetic field of the permanent magnet against the spring force of the spring means (page 3, lines 10 to 16), in which the armature lies against the free end of the first yoke leg (fig.2) and in which the armature can assume a second position under influence of the magnetic field developed by a current flowing through the coil and exceeding a predetermined limit value (page 3, lines 18 to 23 and fig.3), in which the surfaces facing each other of armature and free end of the first yoke leg are at a first air gap distance from each other (fig.3).

The subject-matter of claim 1 therefore differs therefrom in that the armature is

pivotally supported by the supporting yoke leg, the magnet is included in a second magnetic circuit formed by the yoke and the armature, the second magnetic circuit having, in the first position of the armature, a higher reluctance than that of the first magnetic circuit, this reluctance decreasing when the armature moves from the first to the second position.
The subject-matter of claim 1 is therefore novel (Article 33(2) PCT).

The problem to be solved by the present invention may therefore be regarded as how to contrast the increasing force of the spring when the armature is moving to its second position.
The solution to this problem proposed in claim 1 is considered as involving an inventive step (Article 33(3) PCT) for the following reasons.
As the armature moves to its second position, the reluctance of the second circuit decreases thanks to a decrease in the air gap. The attractive magnetic force thus increases, contrasting the increase in the opposing elastic force exerted by the spring.

3 **Claims 2 to 18** are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Re Item VII

Certain defects in the international application

1 Although claim 1 is drafted in the two-part form the feature according to which the armature is pivotally supported by the supporting yoke leg is incorrectly placed in the preamble, as it is not disclosed in document D2 in combination with the features placed in the preamble (Rule 6.3(b) PCT).

2 The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

3 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclos d in the document D2 is not mentioned in the description, nor is this

INTERNATIONAL PRELIMINARY EXAMINATION REPORT - SEPARATE SHEET

International application No. PCT/NL00/00009

document identified therein.

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:
DE BRUIJN, Leendert, C.
Nederlandsch Octrooibureau
Scheveningseweg 82, P.O. Box 29720
NL-2502 LS The Hague
PAYS-BAS

Nederlandsch Octrooibureau
INGEK. 24 JUL 2001

Date of mailing (day/month/year) 13 July 2000 (13.07.00)	
Applicant's or agent's file reference BO 42179 EE	IMPORTANT NOTICE
International application No. PCT/NL00/00009	International filing date (day/month/year) 06 January 2000 (06.01.00)
Priority date (day/month/year) 06 January 1999 (06.01.99)	
Applicant HOLEC HOLLAND N.V. et al	

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   AU,CN,JP,KP,KR,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CR,CU,CZ,DE,DK,DM,EA,EE,EP,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZW
   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   13 July 2000 (13.07.00) under No. WO 00/41201

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a **demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer J. Zahra Telephone No. (41-22) 338.83.38

Form PCT/IB/308 (July 1996)

3986331

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 12 September 2000 (12.09.00)	
International application No. PCT/NL00/00009	**Applicant's or agent's file reference** BO 42179 EE
International filing date (day/month/year) 06 January 2000 (06.01.00)	**Priority date** (day/month/year) 06 January 1999 (06.01.99)
Applicant HEMMER, Aloysius, Gerardus, Majella	

1. The designated Office is hereby notified of its election made:

   [X] in the demand filed with the International Preliminary Examining Authority on:

   31 July 2000 (31.07.00)

   [ ] in a notice effecting later election filed with the International Bureau on:

   _____

2. The election [X] was

   [ ] was not

   made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Olivia TEFY
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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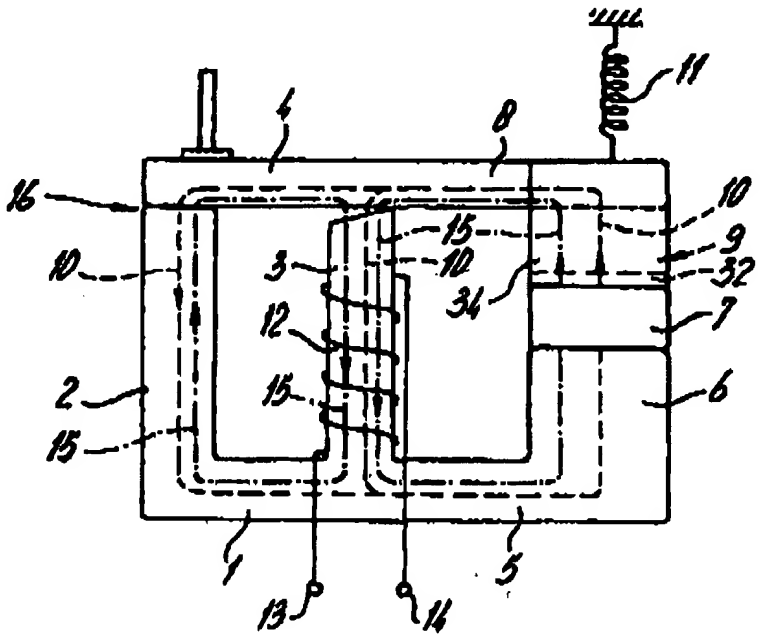
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: TRIP SYSTEM FOR AN ELECTRICAL SWITCH HAVING A FAVOURABLE FORCE-PATH-CHARACTERISTIC

(57) Abstract

Trip system for an electric switch, comprising a yoke of magnetic material, consisting of a yoke base part, a first yoke leg and a second supporting yoke leg, said first and second yoke legs extending at a mutual spaced relation and in the same direction from the yoke base part, an armature from magnetic material bridging the free ends of the yoke legs and supporting pivotably by the supporting yoke leg, a permanent magnet provided such that its magnetic field lines extend through the yoke and the armature, a coil mounted on the yoke and spring means engaging the armature. The armature is held in a first position under influence of a magnetic field of the permanent magnet in opposite direction of the spring force of the spring means, in which the armature engages the free end of the first yoke leg. The armature may assume a second position under influence of the magnetic field developed by a current flowing through the coil and exceeding a predetermined limit value, in which surfaces facing to each other of the armature and the free end of the first yoke leg are spaced by a first air gap distance. The magnet is included in a second magnetic circuit formed by a yoke and the armature and having in the first position of the armature a magnetic resistance higher than that of the first magnetic circuit and which increases when the armature moves from the first to the second position.



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JC18 Rec'd PCT/PTO 06 JUL 2001

Trip system for an electrical switch having a favourable force-path-characteristic.

The invention relates to a trip system for an electrical switch, comprising a yoke of magnetic material, consisting of a yoke base part, a first yoke leg and a second supporting yoke leg, said first and second yoke legs extend in the same direction from the yoke base part, transversely thereto and in mutual spaced relation, an armature from magnetic material, bridging the free ends of the yoke lets and supported pivotably by the supporting yoke leg, a permanent magnetic, provided such that its magnetic field lines extend through a first magnetic circuit formed by the yoke and the armature, a coil mounted on the yoke and spring means engaging the armature, in which the armature is held in a first position under influence of the magnetic field of the permanent magnet against the spring force of the spring means, in which the armature lies against the free end of the first yoke leg and in which the armature can assume a second position under influence of the magnetic field developed by a current flowing through the coil and exceeding a predetermined limit value, in which the surfaces facing to each other of the armature and free end of the first yoke leg at a first air gap distance from each other.

Such a trip system is known from the Dutch patent application 1004438.

Trip systems for electrical switches, for example earth leakage switches, have to serve the purpose to unlock a main switch mechanism biased by springs with minimum switching energy/costs or tuned switching energy, so that the earth leakage switch could be opened.

The above mentioned known trip system operates by unlocking a magnetic circuit closed by means of the permanent magnet. This magnetic circuit is formed by the two-leg yoke, the pivotable armature and the permanent magnet. The armature is arranged pivotable and thereby supported by a supporting yoke leg of the yoke, while between the other yoke leg and the armature an air gap is provided, which can be opened or closed by rotating the armature. The permanent magnet is provided in a recess of the other yoke leg. On one of the two yoke legs a coil is provided. A spring is arranged such between armature and yoke that said spring can provide the air gap opening force on the armature. The permanent magnet provides the air gap closing force. The spring is in the position of the armature in which this lies against the free end face of the first yoke leg, so that in this spring the energy is accumulated, by which a main switch mechanism can be unlocked. The pretension of the spring is just not high

enough to remove the force exerted on the armature by the permanent magnetic field in the magnetic circuit and to open the air gap between armature and first yoke leg.

By exciting the winding the magnetic field from the permanent magnet is cancelled partly, by which the spring can open the air gap between armature and first yoke leg and thereby, can deliver the accumulated mechanical energy to a main switch mechanism. Thereby it is achieved that the trip system is unlocked with minimum energy.

This known trip system has, however, still the disadvantage that the more the energy is opened further, the spring detentions, by which the opening force on the armature decreases.

The invention has the object to provide a trip system of the kind mentioned above, in which said disadvantage is obviated, the accuracy of the trip system is further improved and the manufacturing is simplified as much as possible.

This object is achieved according to the invention, in that the magnet is included in a second circuit formed by the yoke and the armature, said circuit having a magnetic resistance in the first position of the armature, which resistance is higher than that of the first magnetic circuit and decreases in the movement of the armature from the first to the second position. Thereby the opening performance of the armature is improved and a more or less force-path-characteristic of the trip system is achieved, when this comes to action.

The magnetic resistance varying dependent on the armature movement compensates for the varying force of the spring means during the armature movement.

The varying magnetic resistance can be achieved by using an air gap in the second magnetic circuit arranged such that this air gap decreases when the spring force of the spring means on the armature decreases during the movement of the armature from the first position to the second position.

In a first embodiment the yoke base part is provided with a yoke base part extension, extending beyond the supporting yoke leg and merging into a third yoke leg extending spaced from the supporting yoke leg and in the same direction thereof, in which a permanent magnet is added to the magnetic path of yoke base part extension and a third yoke leg and in which the armature is extended and overlaps the free end face of the assembly of yoke base part extension, third yoke leg and permanent magnet at a second air gap distance, when the armature is in the first position.

In a second embodiment the armature has two legs, the one armature leg of which bridging the space between the first yoke leg and the supporting yoke leg and the second armature leg of which extends transversely to the one armature leg and at a distance from the supporting yoke leg, in which a space remains between the faces facing to each other of the second armature leg and the supporting yoke leg for accommodating the permanent magnet with a second air gap.

Preferable and advantageous embodiments of the invention are described in sub claims.

The invention will be explained hereafter by reference to the drawings, in which:

Figure 1 shows schematically an embodiment of the invention;

Figure 2 represents a side view of the embodiment of figure 1;

Figure 3 illustrates an elaborated embodiment of the trip system according to the invention;

Figure 4 represents a side view of the embodiment of figure 3; and

Figure 5 shows a preferred embodiment of the trip system according to the invention.

The trip system shows schematically in figure 1 comprises a yoke of magnetic material consisting of a yoke base part 1, a first yoke leg 2 and a second supporting yoke leg 3. The trip system is provided further with an armature 4, supported pivotably or tiltably by the supporting yoke leg 3. The yoke base part 1, the first yoke leg 2, the armature 4 and the supporting yoke leg constitute a first magnetic circuit. A configuration and the operation of a trip system having such a single magnetic circuit is described for example in the Dutch patent application 1004438.

In order to obviate the disadvantages mentioned in the introductory part a second magnetic circuit is used according to the invention. The magnet is included in the second magnetic circuit formed by the yoke and the armature and which has a magnetic resistance in the first position, which is higher than that of the first magnetic circuit and which decreases during the movement of the armature from the first to the second position.

In the embodiment shown in the figures 1-4 at the one side and figure 5 at the other side, the solution for obtaining a second magnetic circuit is looked for in the shape of the yoke and the shape of the armature respectively. By using the second magnetic circuit it is possible to obtain an additional air gap varying in dimension such

that the adverse variation of the spring means effective on the armature in the known trip system is eliminated or even overcompensated.

In the embodiment of figure 1 the second magnetic circuit is obtained in that the yoke of magnetic material further comprises a yoke base part extension 5 continuing as third yoke leg 6. A permanent magnet 7 is added to the yoke base part extension 5 and a third leg 6. This permanent magnet 7 is provided on the free end face of the third yoke leg 6. However, it is also possible to include the permanent magnet 7 anywhere in the yoke base part extension or in the third yoke leg 6. The armature 4 has an armature part 8 extending by such a distance beyond the supporting yoke leg 3, that this armature part 8 overlaps the free end of the permanent magnet 7, in which an air gap 9 remains in a position shown in figure 1 between the surfaces facing to each other of the armature part 8 and the permanent magnet 7.

The left hand end of the armature 4 lies against the free end face of the first yoke leg 2 in the so called closed position shown in figure 1. The armature 4 is holded by the permanent magnet 7 in this condition. The flux lines 10 originating from the permanent magnet 7 are distributed over the first yoke leg 2 and the supporting centre yoke leg 3. By the flux lines 10 a force is exerted on the said components at the location of the faces lying on each other of the armature 4 and the first yoke leg 2, by which the said faces are holded against each other. The compression spring 11 is biased in the closed condition of the trip system shown in figure 1 and a force is acting opposite to a force generated by the flux lines 10 at the location of the faces of armature 4 and first yoke leg lying on each other. The force originating from the bias of the compression spring 11 is, however, just not sufficient to pivot the armature 4 to the right.

The second supporting yoke leg 3 is provided with a coil 12. When the trip system is used with an earth leakage switch, a control current is supplied to the terminals 13 and 14 of the coil 12. This control current is directed such that in the second supporting yoke leg 3 flux lines 15 are established, which at the one side extend through the armature part 4, the first yoke leg 2 and the yoke base part 1 and at the other side through the armature part 8, the third yoke leg 6 and the yoke base part 5. The opposite flux 15 has a preference for leg 2 because of the air gap 9 and permanent magnet operating also as a air gap for flux 15. When a control current is sufficiently high and thus exceeds a predetermined limit value, the flux 10 is decreased by the oppositely directed flux 15 in the air gap 16, which is produced by the control current,

so that by the bias of the compression spring 11 the armature 4, 8 may turn to the right, during which the mechanical energy accumulated in the compression spring 11 is used. Thereby a first air gap 16 is established between the surfaces facing to each other of the armature part 4 and the first yoke leg 2. The air gap 9 is thereby decreased. The effect of the compression spring 11 is decreased during turning. However, the air gap 9 is decreased during this turning and an increasingly greater force will act on the armature part 8 by the magnet 7 resulting from the decreasing air gap 9. By the effect of the decreasing air gap 9 a more or less hollow force-path characteristic of the trip system is obtained. The flux generated through the coil amplifies the field of the permanent magnet in the air gap 9.

By the trip system according to the invention the magnitude of the second air gap and the spring force of the compression spring are dimensioned such, that in the first position of the armature, the moment of the attracting force between armature and engaging yoke leg is bigger by a predetermined value than the sum of the moments of the attracting force at the second air gap and the spring force acting on the armature. The moments are defined with respect to a point, e.i. the pivot point of the armature on the supporting yoke leg 3. Said predetermined value is then dependent on the selected limit value of the coil current, above which the trip system must come to action.

The embodiment of the trip system according to the invention shown in figure 3 is assembled from a three-leg yoke from magnetic material and a pivotable armature, also from magnetic material. The armature 4 is supported pivotable or tiltable by the supporting yoke leg 3. This supporting yoke leg 3 is connected to the first and third yoke legs 2 and 6 respectively by the yoke base parts 1, 5.

The trip system has two stable conditions, an open condition in Figure 3, in which the air gap 16 is opened and a closed condition in Figure 1, in which the air gap 16 is closed. The closed condition of the armature 4 is also indicated by a dotted line in Figure 3.

The first yoke leg 2 and the third yoke leg 6 have different lengths. The first yoke leg 2 could be shorter or longer than the supporting yoke leg 3, however, it is simpler in manufacturing when these two yoke legs have the same length. The armature engages the first yoke leg 2 and the supporting centre yoke leg 3 in the position shown by a dotted line.

The third yoke leg 6 is shorter than the other yoke legs, so that space remains between the free end face of the third yoke leg 6 and the armature 4 for accommodating a permanent magnet 7 and the armature part 8 in the closed condition of the trip system.

The magnetic field of the permanent magnet 7 is closed through the first yoke leg 2 and the second supporting yoke leg 3 and further through the third yoke leg 6 in the closed condition shown by a dotted line.

For the purpose of a well-defined and easy pivoting of the armature 4, 8 the free end face of the supporting yoke leg 3 is bevelled. Thereby a wedge-shaped air gap is produced in the closed condition of the trip system, so that a greater part of the flux generated by the permanent magnet flows through the air gap 16 than through the supporting leg 3.

The trip system is provided with spring means implemented as a compression spring in form of a leaf spring 17 as shown in Figure 3. This leaf spring 17 could have a larger width than the armature 4, 8. Moreover the leaf spring may have different shapes depending on desired initial and end force. For example this leaf spring 17 could tapper or widen stepwise. Naturally also a coil spring is possible.

The leaf spring 17 engages at one end against the top side of the armature anywhere between the supporting yoke leg and third yoke leg. The other end of the leaf spring 17 is connected fixedly to the housing 18. The spring is clamped by means of a cam 28 against the cams 19 and 20 of the housing or fixed in another way in the housing. The leaf spring 17 biases the armature in the decreasing direction of the second air gap 9. The leaf spring 17 is fixed to the surface 19 of the housing 18. The leaf spring 17 engages the cam face 20 of the housing between its two ends. The leaf spring 17 defines an acute angle with the upper face of the armature 4, 8. This angle could also be zero in the second open condition. However, the space for the trips 21 must be taken into account. When the angle between leaf spring 17 and upper surface of the armature 4, 8 is zero in the closed condition, the inner wall should have a more complicated shape, in particular at the surfaces 19 and 20.

The leaf spring 7 is pushed away when the air gap 16 is closed and this leaf spring 17 is dimensioned such, that said spring compensates nearly the attracting force over the air gap 16, but not completely. Thereby the trip system is "sharpened".

The air gap between the armature part 8 and the permanent magnet 7 is nearly closed in the open condition, whereas the air gap 16 is opened. The leaf spring 17 exerted a selected end force in this open condition.

In order to come from the closed in the open condition a coil 12 having a coil holder 22 is provided on the supporting yoke leg 3. By energising said coil a flux is generated running in the same direction as the flux from the permanent magnet 7 between the surfaces facing to each other of the armature 4, 8 and permanent magnet 7.

The air gap 16 will be much smaller than the air gaps at the other end of the armature 4, 8 in the closed condition of the trip system, so that a higher flux produced by the coil will extend through the first yoke leg 2 than through the third yoke leg 6. The flux generated by the permanent magnet at the air gap 16 is counteracted by the flux produced by the coil. Thereby the magnetic attracting force over the air gap 16 will decrease and the armature will turn to the open condition under influence of the biased leaf spring 17.

During turning to the right of the armature 4, 8 the air gap 9 between the armature 4, 8 and the permanent magnet 7 will decrease more and more, so that the attracting force between armature and assembly of third yoke leg 6 and permanent magnet 7 increases, so that also the force on the trips 21 increases as the opening in the air gap 16 increases. Thus also in this case, the advantage of a more or less hollow force-path characteristic is achieved by which the main mechanism of the earth leakage switch can be unlocked more liable.

The yoke and the armature could be punched out from plate material in a known way. First the coil is placed around the supporting yoke leg. The yoke and the armature and the further components are placed subsequently in a plastic housing preferably divided longitudinally in two parts. In the assembling of the known trip system the magnet is placed in the housing, by which the magnetical system is sensitive to the magnetizable dust. Always some magnetizable dust adheres to a permanent magnet, unless this is mounted in a dust free space. The dust disturbs the good function of the trip system, because the air gap 16 may be contaminated. In order to remove said problems. the permanent magnet is provided in a recess of the housing, which recess is defined by the housing wall parts 23, 24 and 25. As said recess is accessible from the outside. the permanent magnet 7 can be shifted in said recess afterwards, i.e. after all of the other components are accommodated and closed in the trip system housing 18, and

consequently it is possible to place the magnets under normal production circumstances, because dust eventually adhered cannot come into important air gaps.

The accuracy of the orientation of the end surface of the first yoke leg 2 with respect to the surface of the engaging armature 4 represents a problem in punching the yoke leg. The length of the first yoke leg 2 would be preferably exactly equal to the length of the supporting yoke leg 3. By punching or grinding the upper side of the first yoke leg 2 into a nearly convex shape, some tolerance as to the length of the first yoke leg 2 and the supporting yoke leg 3 is allowed. This is at the cost of the air gap 7 but does not disturb the good operation.

The third yoke leg 6 is reasonable width in connection to the dimensions of the permanent magnet 7. The coil holder 22 is bevelled at 26 to create space for the leaf spring 17. Further the coil holder 22 is provided with guiding means 27. The housing 18 is provided with guiding means 28 for guiding the armature 4, 8 when it pivots.

The armature 4, 8 have rounded corners at the end for matching in the housing and for preventing it from scraping against the housing. The corner 29 of the armature 4, 8 can be bevelled such that a larger engaging surface against the housing wall part 23 is produced, which bevelled surface can be used for tuning the attracting force over the air gap between said wall part and armature.

The housing is provided with a curved inner housing surface 30 with a predetermined radius for guiding the armature. This radius corresponds to the radius of the path travelled by the right hand end of the armature 4, 8 when it pivots. Because the inner wall surface 30 guides the engaging end of the armature, pivoting takes always place well defined and accurately.

It appears most clearly from Figures 2 and 4 that a U-shaped pole shoe 31 is added to the permanent magnet 7. The base part 32 of the pole shoe engages the surface of permanent the magnet 7 facing to the armature 8. The legs 33 and 34 extending perpendicular to the base part 32 of the pole shoes define with said base part 32 a space in which the armature 4 is accommodated.

By using the U-shaped pole shoe the air gap between armature and permanent magnet is decreased. The advantage thereof is that a smaller permanent magnet could be used.

The field lines in the closed condition, i.e. closed air gap 16, around the armature in air gap 9 exits horizontally in the direction to the U-shaped pole shoe. By this course

of the field lines nearly no vertical attracting force on the armature occurs in this condition. The more the armature pivots further to the right, the vertical attracting force is bigger.

The U-shaped pole shoe is provided outside of the housing of the trip system as shown in Figure 2. In this case the armature moves between the sidewalls of the housing 18.

The preferable embodiment shown in Figure 5 comprises a two-leg yoke of magnetic material consisting of a first yoke leg 2 and a second supporting yoke leg 3. The trip system is further provided with an armature 4, supported pivotable by the supporting yoke leg 3. The armature has two legs 35 and 36 the one armature leg 35 of which bridging the space between the first yoke leg 2 and the supporting yoke leg 3. The armature leg 35 lies against the first yoke leg 2 in the closed condition shown in Figure 5. The second armature leg 36 is substantially perpendicular to the armature leg 35 and defines with the surface facing to the supporting yoke leg 3 and the corresponding surface of the supporting yoke leg 3 a space in which the permanent magnet 7 is accommodated.

The yoke leg 2 is provided with a coil 12 having terminals 13 and 14.

In this embodiment the yoke is simpler, however, the shape of the armature 4 is somewhat more complex.

Because the permanent magnet 7 is placed transversely to the yoke leg 3 and the armature is extended in stead of the yoke, in this case by a part being squared, the air gap 9 could be made smaller by decreasing the distance of the permanent magnet 7 to the pivoting point of the armature. Thereby an even more compact construction is achieved. The field lines of the permanent magnet follow now a path via the supporting yoke leg 3, the yoke 1, the yoke armature part 35 and the extended part 36 of the armature.

The operation of this embodiment is in fact identical to that of the embodiment of the Figures 1 and 2.

Furthermore it is observed, that the permanent magnet may be provided with a U-shaped pole shoe also in this case.

CLAIMS

1. Trip system for an electrical switch, comprising a yoke of magnetic material, consisting of a yoke base part, a first yoke leg and a second supporting yoke leg, said first and second yoke legs extend in a mutual spaced relation and in the same direction from the yoke base part and transversally thereto, an armature from magnetic material bridging the free ends of the yoke legs and pivotably supported by the supporting yoke leg, a permanent magnet provided such that its magnetic field lines extend through a first magnetic circuit formed by the yoke and the armature, a coil mounted on the yoke and spring means engaging the armature, in which the armature is held in a first position under influence of the magnetic field of the permanent magnet against the spring force of the spring means, in which the armature lies against the free end of the first yoke leg and in which the armature can assume a second position under influence of the magnetic field developed by a current flowing through the coil and exceeding a predetermined limit value, in which the surfaces facing to each other of armature and free end of the first yoke leg are at a first air gap distance from each other, characterised in that the magnet is included in a second magnetic circuit formed by the yoke and the armature and which in the first position of the armature has a magnetic resistance being higher than that of the first magnetic circuit and is decreasing when the armature moves from the first to the second position.

2. Trip system according to claim 1, characterised in that the yoke base part is provided with a yoke base part extension, extending beyond the supporting yoke leg and emerging into a third yoke leg running spaced from the supporting yoke leg and in the same direction thereof, that the permanent magnet is added to the magnetic path of the yoke base part extension and third yoke leg and that the armature is extended and the free end face of the assembly of yoke base part extension, third yoke leg and permanent magnet overlaps at a second air gap distance when the armature is in the first position.

3. Trip system according to claim 1, characterised in that the armature has two legs, the one armature leg of which bridging the space between the first yoke leg and the supporting yoke leg and the second armature leg of which ext nding transversely to the

one armature leg and at a distance from the supporting yoke leg, in which a space between the surfaces facing to each other of the second armature leg and the supporting yoke leg remains for accommodating the permanent magnet with a second air gap.

4. Trip system according to claim 2 or 3, characterised in that the magnitude of the second air gap and the spring force of the spring means on the armature are selected such that in the first position of the armature the moment of the attracting force between armature and engaging yoke leg is bigger by a predetermined value than the sum of the moments of the attracting force at the location of the second air gap and the spring force acting on the armature, said moments are valid with respect to the armature pivoting point and that said value is related to the limit value of the coil current.

5. Trip system according to one of the claims 1-4, characterised in that the free end face of the supporting yoke leg and the surface facing thereto of the armature define a wedge-shaped space.

6. Trip system according to one of the claims 1-5, characterised in that the spring means are completely or partly released in the second armature position.

7. Trip system according to one of the claims 2-6, characterised in that the spring means are constituted by a compression spring engaging the armature part between supporting yoke leg and third yoke leg and bias the armature in the direction of decreasing of the second air gap.

8. Trip system according to claim 7, characterised in that the compression spring is a leaf spring engaging at one end against the armature part between supporting yoke leg and third yoke leg and is fixed at the other side in the housing of the trip system, in which in a position differing from the second position of the armature a leaf spring and the armature defines an angle.

9. Trip system according to claim 8, characterised in that the leaf spring engages a cam of the housing between the fixed end and the free end of the leaf spring.

10. Trip system according to one of the claims 1, 2, 4-9, characterised in that the permanent magnet is accommodated in a recess in a house wall located between the free end face of the third yoke leg and the armature surface facing thereto.

11. Trip system according to claim 10, characterised in that the recess is accessible from the outside.

12. Trip system according to one of the claims 1-11, characterised in that the supporting yoke leg and the first yoke leg has substantially the same length.

13. Trip system according to one of the claims 1-12, characterised in that the free end face of the first yoke leg is rounded.

14. Trip system according to one of the preceding claims, characterised in that the housing and coil holder are provided with mechanical guiding faces for the armature.

15. Trip system according to one of the preceding claims, characterised in that the armature has rounded corners at the ends.

16. Trip system according to one of the claims 1, 2, 4-15, characterised in that the armature part lies against the free end of the assembly of yoke base part extension, third yoke leg en permanent magnet with a bevelled surface in the second armature position.

17. Trip system according to one of the preceding claims, characterised in that the armature end engages a curved house part during the pivoting movement of the armature, the radius of said curvature corresponds to the radius of the path covered by the end of the armature located above the third yoke leg.

18. Trip system according to one of the preceding claims, characterised in that the permanent magnet is provided at its surface facing to the armature with a U-shaped pole shoe, the base of which extending parallel to said surface of the permanent magnet and the legs of which are running perpendicular to and in a direction of the said surface,

in which the armature is accommodated movable in a space defined by the base and the legs.

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WO 00/41201 PCT/NL00/00009

fig-1

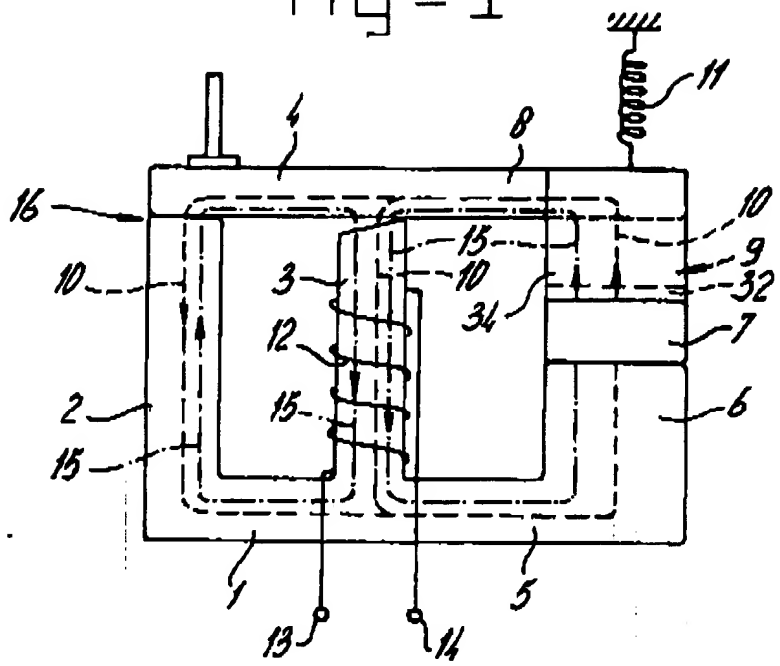

fig-2

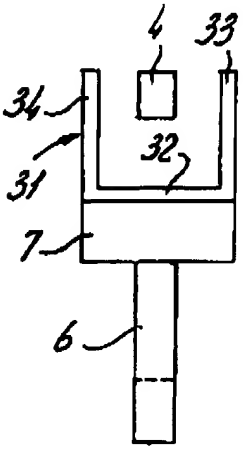

fig-3

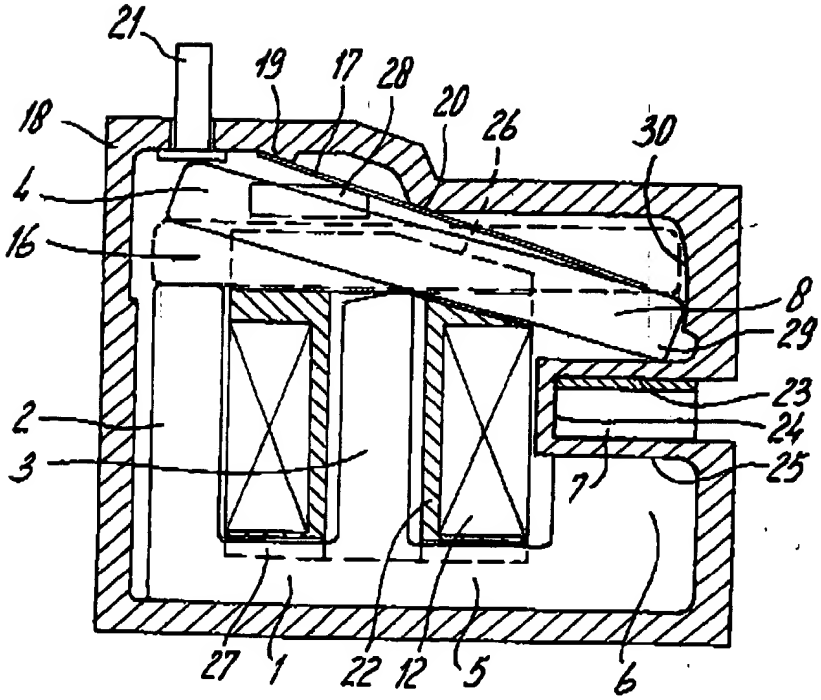

fig-4

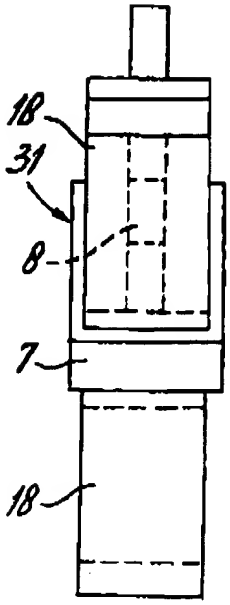

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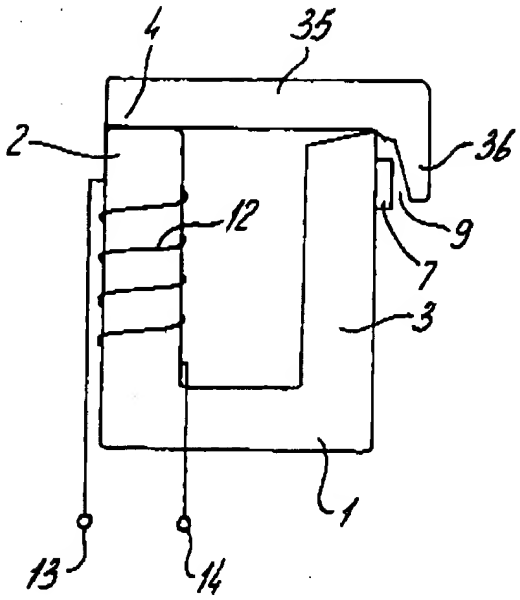
Fig - 5



INTERNATIONAL SEARCH REPORT

International Application No
PCT/NL 00/00009

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01H71/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	FR 2 261 614 A (GARDY STE FRANCAISE) 12 September 1975 (1975-09-12) page 3, line 17 - line 33; figures 1-3	1,2
Y	FR 2 697 670 A (MERLIN GERIN) 6 May 1994 (1994-05-06) abstract; figures	1,2
A	FR 2 410 353 A (MERLIN GERIN) 22 June 1979 (1979-06-22) claim 1; figures 1,2	1,2
A	DE 16 39 196 A (ROBERT BOSHOF) 21 May 1970 (1970-05-21) page 4, paragraph 2; figure 5	3

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[X] Further documents are listed in the continuation of box C. [X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 March 2000	08/03/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Janssens De Vroom, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/NL 00/00009

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 42 40 031 A (FELTEN & GUILLEAUME ENERGIE) 1 June 1994 (1994-06-01) abstract; figures 1,4	1,2

INTERNATIONAL SEARCH REPORT

information on patent family members

Inter nal Application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2261614 A	12-09-1975	BE 825453 A	29-05-1975
		DE 2505867 A	28-08-1975
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		ZA 7500868 A	28-01-1976
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DE 4240031 A	01-06-1994	AT 137059 T	15-05-1996
		DE 59302296 D	23-05-1996
		WO 9413003 A	09-06-1994
		EP 0671054 A	13-09-1995
		FI 952570 A	26-05-1995
		NO 950024 A	04-01-1995

ENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Artic 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION** see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
BO 42179 EE		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/NL 00/ 00009	06/01/2000	06/01/1999
Applicant		
HOLEC HOLLAND N.V. et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

   [X] as suggested by the applicant.

   [ ] None of the figures.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.